during the last few years, devoted much attention to the meteorology of Siberia, and, besides the meteorological observations made at its stations, it has collected materials for ascertaining the dates of the freezing and breaking up of the ice in Siberian rivers. The list of these dates for the rivers of Siberia for the years 1874 to 1880 will certainly be consulted with profit, as also several brief notes on amber in Siberia, on chemical analyses of salt from various salt lakes, and of coral from the Nerchinsk district, and from the banks of the Amur, as also other smaller notes.

EXPERIMENTAL RESEARCHES ON THE ELECTRIC DISCHARGE WITH THE CHLORIDE OF SILVER BATTERY[1]

THE authors recall that at the conclusion of the third part of their researches (*Phil. Trans.* for June 11, Part I. vol. clxxi.) they stated that they intended to make an investigation on the dark discharge, and the special conditions of the negative discharge; this paper contains a number of experiments, more especially on the latter subject, and also others intended to throw light on the general nature of the electric discharge through gases.

The first part of the paper describes some experiments made with vessels of different forms in order to ascertain whether the dimensions and shape of the vessel have any effect on the pressure of minimum resistance to the electric discharge. This was found to be the case; for example, with a residual air charge in a spheroidal vessel 7 inches (17·8 centims.) long, and 5 inches (12·7 centims.) diameter (Fig. 1), the pressure of minimum resistance was as high as 3 millims., 3947 M; while in a tube 22·5 inches (57 centims.) long, and 1·625 inches (4·1 centims.) diameter, it was only 0·69 millim., 908 M; again in a smaller tube 23 inches (58·4 centims.) long, and 0·75 inch (1·9 centims.) diameter, it was 1 millim., 1316 M. It is evident, therefore, that not only the dimensions of the tube, but possibly also the shape of the terminals, have an influence on the pressure of least resistance, and it is very probable that in the atmosphere, where lateral expansion is practically unlimited, the conditions of minimum resistance are different from those which exist even

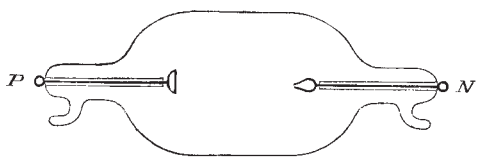

FIG. 1.

in very large tubes, and that this may influence the height of the aurora.

The paper next deals with the discharge in miniature tubes $\frac{7}{8}$ inch (2·2 centims.) long, and $\frac{1}{4}$ inch (0·63 centim.) diameter, with terminals nearly touching; at first it required 2400 cells to pass, then a single cell would do so, but after standing a short time it required 4800 cells to reproduce a discharge. In another tube $1\frac{3}{4}$ inch (4·4 centims.) long and $\frac{3}{8}$ inch (0·95 centim.) diameter), with the terminals distant 0·00104 inch (0·0264 millim.), it required 2240 cells to produce a discharge, then the potential had to be increased to 11,240 cells to do so. Ultimately even this number failed, but after the tube had lain by for some days 600 cells could pass. It is very possible that the strong discharge in the first instance volatilised a portion of the terminals which were of platinum, and that this volatilised metal condensed afterwards, or else that the terminals absorbed the gas so completely as to produce a vacuum too perfect to admit of a discharge taking place; and that ultimately sufficient of the occluded gas was again given off to render it again possible.

In connection with the occlusion of gas by terminals a case is described in which the terminals are of palladium and the charge hydrogen (Fig. 2). After a few discharges the terminals occluded some of the gas, and when a fresh one was produced a volatile compound of hydrogen and palladium was given off, especially from the negative, and produced a dense, mirror-like coating on the inside of the tube (Fig. 3); this was reoccluded by standing for a couple of days, leaving the tube free, and again given off to form a new mirror-like coating with a fresh discharge; this property has continued since March, 1875.

The paper next describes experiments to ascertain the length of the spark in dry air and in air saturated with moisture. It was found to be practically the same in both cases. With 10,860 cells the mean length of the spark between two paraboloidal points was found to be in dry air 0·45 inch (1·1 centims.), in moist air 0·447 inch (1·1 centims.).

The next subject taken up is the discharge in a tube from two batteries, first in the same and then in contrary directions. In the tube are two terminals at each end, one pair at opposite ends being inclosed in two short pieces of tube 9 inches (22·8 centims.) long and $\frac{1}{2}$ inch (1·27 centims.) diameter; the main tube being 31 inches (95·2 centims.) long and $1\frac{3}{4}$ inch (4·4 centims.) diameter. The various phases of the stratified discharge are represented in an engraved mezzotint steel plate copied from photographs, and show the effect of the one stratified discharge on another stratified discharge produced by a second battery. It is seen that two discharges in contrary directions may take place in the same tube, and that the one modifies the aspect of the other.

Experiments are also described in a tube in the form of a cross with four arms at right angles (Fig. 4), with two separate batteries connected in various ways with the different members.

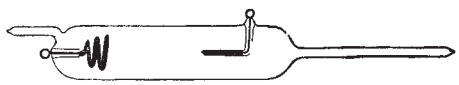

FIG. 2.

The experiments were made both in air and in hydrogen. By the introduction of external resistance of one of the batteries, the discharge could be readily identified as belonging to that battery by the effect of the resistance on the character of the stratification. In one of the mezzotint plates are several figures copied from photographs which show clearly the phenomena produced. Calling the poles P and N of one battery, A, and P′ and N′ of the other, B, it is shown in one case when two currents were equal 0·0083 ampere, that a discharge from A battery goes from P in the direction of N only so far as the junction at the cross, and then turns off to N′, the negative of the other battery B; while, on the other hand, the discharge of the B battery goes from P′ to N of the A battery. The case is different if an external resistance is introduced in one of the discharges, reducing it to 0·00087 ampere, then the discharge of the A battery goes from P to N, and that of the B battery from P′ to N′. There is a bending down, however, of the strata of the weaker discharge of the cross junction, in consequence of the action of the stronger one.

The authors remark that one cannot but be impressed, from the experiments described in the paper, and others in their former papers, by the apparent plasticity of the aggregate assem-

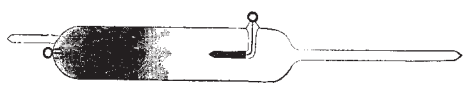

FIG. 3.

blage of molecules constituting a stratum which yields to external influences that modify its form.

The authors describe and figure a case of complex strata in the form of an outer bracket convex towards the negative (Fig. 5), and close to it an inner chord; also discharges in various gases in tubes of large dimensions, 37 inches (94 centims.) long, and $5\frac{13}{16}$ inches (14·8 centims.) diameter. In these the stratification, which is comparatively narrow at the terminals, extends in a conical form from the terminals to the full diameter of the tube.

They have found that the dark space in the discharge in vacuum tubes is only relatively actinically dark in comparison with a stratum, and they succeeded in obtaining a photograph of the dark space in thirty-five minutes as strong as that from a stratum in two and a half seconds; consequently they conclude that the dark space is 840 times less actinically bright than a stratum.

The authors next describe a number of experiments, by means of a Thomas-Becker electrometer used on a method, to avoid leakage, proposed to them by Prof. Stokes, to ascertain the difference of potential in different parts of a vacuum tube having a number of rings sealed within it, also in other tubes of special construction. These bring out instructive information, in reference not only to the relative resistances of different lengths of a

[1] Abstract of a paper read at the Royal Society on June 14, by Warren De La Rue, M.A., D.C.L., F.R.S., and Hugo W. Müller, Ph.D., F.R.S.

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column of gas at various pressures, but also forcibly to the impediment presented by the terminals themselves to the passage of a discharge from gas to terminal and terminal to gas.

It is shown that, at moderate exhausts, the resistance to the passage of the discharge is uniform along the length of the column of gas, and that at high exhausts it is not so, and that the total resistance increases but slightly with an additional length of the column; moreover, that, at these low pressures, the main impediment is in the passage of electricity between gas and terminal or terminal and gas; this is much greater at the negative than at the positive terminal.

The authors have next studied the electrical condition of a gas in the immediate vicinity of the negative terminal. In order to do this they constructed a tube 4½ inches (11·4 centims.) long and 1⅞ inches (4·8 centims.) diameter. One terminal is in the form of a point, the other in the form of a ring. The positive pole of the battery was connected with the point, and the negative either to the ring alone or to earth as well; the ring terminal of the tube was, when the battery was insulated, connected with earth either by means of a stout wire or 3 feet (91·4 centims.) of fine platinum wire, 0·002 inch (0·005 centim.) diameter, and offering a resistance of 81 ohms, or a moistened

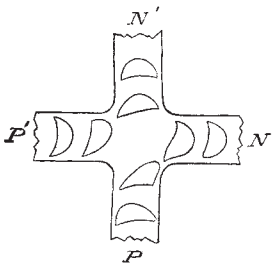

FIG. 4.

FIG. 5.

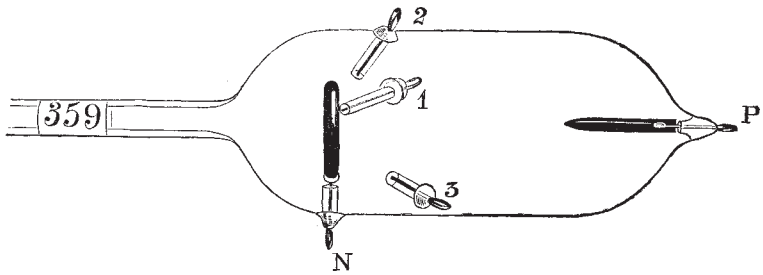

FIG. 6.

cork offering a resistance of 4,300,000 ohms. In the tube were sealed three idle wires, 1, 2, 3, covered with the exception of their extremities with fine glass tubing (Fig. 6). No. 1 idle wire is 0·002 inch (0·005 centim.); No. 2 0·2 inch (0·5 centim.); and No. 3 0·6 inch (1·5 centims.) from the ring. The ring terminal, when connected to earth, was found to be always at zero potential; notwithstanding this there was frequently observed, more especially as the exhaust was increased, a negative potential when the idle wires were connected successively with the electrometer, amounting in one case with an air charge, pressure 0·01 millim., at wire No. 2, to 1068 cells, at wires 1 and 3 to 912 cells. At other times a plus potential was observed. Many experiments were made to determine the precise conditions which developed a negative potential or a positive potential, but unsuccessfully, and it was inferred that this depended on the condition of the discharge itself within the tube. It is certainly very remarkable that, while the potential of the negative ring was absolutely zero, a high negative potential should be developed in its near vicinity.

The authors remark that every one familiar with the appearance of a stratified discharge will have noticed when the negative terminal is a ring, that as the exhaust proceeds a spindle of light

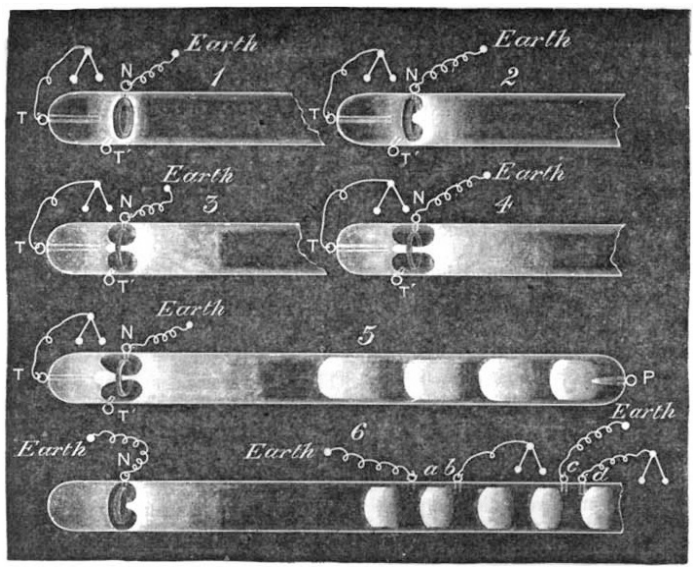

FIG. 7.

approaches and at last protrudes through the interior of it (Fig. 7, 1, 2, 3, 4, 5); this spindle they regard as a visible exponent of strong action among the molecules of gas composing it. In order to probe its electrical condition they prepared a tube with a central idle wire surrounded by a minute glass tube, except its extremity, and projecting to a distance of ⅜ inch (0·95 centim.) from the plane of the ring, which was made negative. Another idle wire was sealed in the tube 0·15 inch (0·38 centim.) from the periphery of the ring. As the exhaust proceeded with a charge of carbonic anhydride, the spindle approached the ring and ultimately protruded through it. It was found that the potential of the central idle wire increased with the exhaust, until it nearly or quite equalled that of the whole tube; while that of the external idle wire was only 0·054 that of the tube.

A great number of experiments were made to test the potential across a stratum *a*, *b*, and across a dark space *c*, *d*, respectively, by two idle wires sealed in suitable positions in a tube, one of which was connected with earth, the other with the electrometer (Fig. 7, 6). The gases used were carbonic anhydride and hydrogen respectively. As a mean of a great number of experiments it was found that when a dark space was straddled,

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the potential being reckoned 1, then when a stratum was straddled the potential was 1·243, 1·229.

On testing two idle wires distant $\frac{5}{8}$ inch (1·6 centims.) apart with a Thomson-Becker galvanometer, the current in this fractional part of a tube was found to go frequently in the reverse direction to that of the main current, and when the galvanometer was connected to two idle wires diametrically opposite, currents

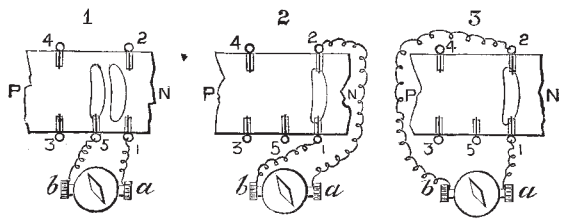

FIG. 8.

were indicated sometimes in one direction, sometimes in another across the tube (Fig. 8). These experiments seem to indicate that there are eddies in the gas during a discharge, as if the motion of the molecules conveying an electric discharge was of an epicycloidal character. The authors conclude by saying that it is possible that the eddies may be connected with the production of strata.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—We are requested to announce that the Savilian Professorship of Geometry is vacant, and an election to the office will be held before the end of Michaelmas Term (December 17). A Fellowship in New College is now annexed to the Professorship. The duty of the Professor is to lecture and give instruction in Pure and Analytical Geometry.

The combined emoluments of the office from both sources will be, for the present, 700*l.* a year, but may possibly hereafter be increased to an amount not exceeding 900*l.* a year.

Candidates are requested to send to the Registrar of the University their applications, and any documents which they may wish to submit to the electors, on or before Wednesday, October 31.

SCIENTIFIC SERIALS

Bulletin of the Belgian Royal Academy of Sciences, June.—On the action of amygdaline during the germination of bitter almonds, by M. A. Jorissen.—Determination of the specific heat of some organic bodies; variations experienced by this quantity through change of temperature, by M. de Heen. Of the eleven substances examined, three only—the formic salts of sodium, calcium, and barium—maintained a perceptibly constant specific heat within the limits of a temperature ranging from 10° to 93° C. A considerable increase of specific heat was shown by most of the other bodies tested.—Note on a double series of equations, by M. E. Catelan.—Anatomical study of the Æschnines (*Æ. grandis* and *heros*), by Baron Edm. de Selys Longchamps. Appended is a complete tabulated classification of the Æschnideæ (Æschna of Fabricius and Latreille).—On a deposit of *Oldhamia radiata* (Forbes) recently discovered in Tubize, Brabant, by M. C. Malaise. From its position in the Brabant schistose system the author is induced to refer this rock to the Lower Cambrian formations.—Attempted determination of the relation $\frac{C}{A}$ of the principal momenta of inertia in the terrestial spheroid, by M. E. Ronkar. In this paper a twofold series of calculations are made, based respectively on the hypotheses of Lipschitz and Laplace regarding the mean density of the crust of the earth.—Note by the editor on the explanation of the prevailing blue colour in large volumes of pure water advanced by M. Montigny.

Annalen der Physik und Chemie, July. — Electrical researches, by G. Quincke.—Researches on the slow discharge, by Heinrich Hertz, with six diagrams.—On the difference in the discharge from the positive and negative electrodes, by H. Hellman of Riga.—New observations on the thermo- and actino-electricity of rock crystal as a reply to a memoir of C. Freidel and J. Curie, by W. Hankel.—On the variation of the magnetic coefficient with the hardness of steel, by Hugo Meyer.—On the coefficient of friction of mercury and its variation with the temperature, by Synesius Koch, with three diagrams.—Theory of light for perfectly transparent light, by W. Voigt.—Concerning the theory of light, by E. Lommel.—On the sound of impinging flames, by K. Noack (three diagrams).—A new apparatus for showing Foucault's streams, by Dr. A. von Waltenhofen.—On the relation between the fundamental note and overtones of transverse vibrations in open metal cylinders, by Hugo Feukner.—On the reciprocal of the strain of closely-tuned elastic bodies, by Dr. G. Krebs.

SOCIETIES AND ACADEMIES

SYDNEY

Linnean Society of New South Wales, June 27.—Prof. W. J. Stephens, M.A., in the chair.—The following papers were read:—Descriptions of new genera and species of fishes by Charles W. De Vis, B.A. Two genera are described, *Dactylophora* of the family *Cirrhitidæ*, and *Leme* of the family *Amblyopina*. The new species described are: *Girella carbonaria*, *Girella neuralis*, *Dactylophora semimaculata*, *Platycephalus semermis*, *Polynemus specularis*, *Leme mordax*, *Sphyræna strenua*, *Trochocopus sanguinolentus*, *Labrichthys dux*, *Plagusia notata*, *Synaptura cinerea*, and *Crossorhinus ornatus*.—A fourth paper on plants indigenous in the immediate neighbourhood of Sydney, by Mr. E. Haviland.—Localities of some species of Polynesian recent mollusca, by John Brazier, C.M.Z.S., &c.

PARIS

Academy of Sciences, August 6.—M. Blanchard, president, in the chair.—Preliminary reports on the transit of Venus, December 2, 1882, at the Transit Stations of Haiti, by MM. D'Abbadie, Callandreau, and Chapuis; of Mexico, by MM. Bouquet de la Grye, Héraud, and Arago; of Martinique, by MM. Tisserand, Bigourdan, and Puiseux; of Florida, by M. Perrier; of Patagonia, by M. Fleuriais; of Chili, by MM. de Bernardières, Barnaud, and Favereau; of Chubut, by M. Hatt; of Monte Video, by M. de Penfentenyo; of Rio-Negro, by M. Perrotin; of Cape Horn, by M. Courcelle-Seneuil; of Bragado, by M. Perrin. These reports, deposited with the Secretary of the Academy on the return of the several expeditions, are here collected together for the convenience of astronomical students.—Active or dynamic resistance of solids. Graphic representation of the laws of longitudinal thrust applied to one end of a prismatic rod, the other end of which is fixed (concluded), by MM. de Saint-Venant and Flamant.—In reply to a recent communication by M. Jamin on the critical point of liquefied gases, a letter was read from Mr. W. Ramsay, who claims priority of discovery, and points out that he had already determined the critical point in a memoir which appeared in the *Proceedings of the Royal Society* for April 22 and December 16, 1880.—On the application of Ampère's method to the investigation of the elementary law of electric induction by variation of intensity, by M. Quet.—On boron, by M. A. Joly. In this paper the author determines the existence of a combination of boron and carbon, reserving for a future communication a study of the various compounds containing these two elements.—On the blood plaquettes of M. Bizzozero, and on Norris's third or invisible blood corpuscle, by M. G. Hayem. It is shown that the so-called "plaquettes," claimed by Bizzozero as a new discovery in the Italian *Archives of Biology* for January, 1882, *et seq.*, are simply the "hæmatoblasts" already described by M. Hayem. On the other hand Norris's "third or invisible corpuscle," which had been identified with the hæmatoblasts, appears not to be a new element at all, but merely an artificial product resulting from the various manipulations to which the blood had been subjected by the English observer.—Experimental researches on some phenomena relative to the absorption of animal fats, by M. A. Lebedeff.—On the true character of the ophthalmic affection known as astigmatic keratite, by M. G. Martin.—New researches on the curve of the muscular shock in various affections of the nervo-muscular system, with three illustrations, by M. Maurice Mendelssohn.—Influence of sea water on freshwater animals, and of fresh water on marine fauna, by M. Felix Plateau.—On barometric pressure in connection with igneous eruptions, by M. Fr. Laur. It is argued that gaseous and other eruptions are due exclusively to rapid variations of atmospheric pressure.

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